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TITLE: MEASURING DEVICE USING LASER BEAM

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ABSTRACT:

PROBLEM TO BE SOLVED: To enhance the measuring accuracy of the concentration and temp. of molecules to be measured by determining the fluorescent intensity emitted from the molecules using a CCD camera, and subjecting the obtained intensity to a normalizing calculation process using a fluorescent intensity given by a sensor.

SOLUTION: A pulse laser for energization 21 energizes a variable wavelength laser 22 to emit a laser beam 24, and a synch. signal is fed to a sensor 28 and a CCD camera 30 through a synch. line 31, and the intensity of the

fluorescent beam emitted by a fluorescent substance applied to a glass plate 27 and the intensity of fluorescent beam emitted by molecules to be measured which are energized with the laser beam 24 cast onto the measuring field 26 are sensed and fed to a computer 32. The computer 32 performs a normalizing calculation process such that the fluorescent intensity of the molecules in the field 26 given from the camera 30 is divided by the fluorescent intensity given from the sensor 28, and the obtained quotient is displayed and emitted as the concentration or temp. of the molecules in the field 26.

(9)

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審査請求　未請求　請求項の数１　ＯＬ　（全４頁）

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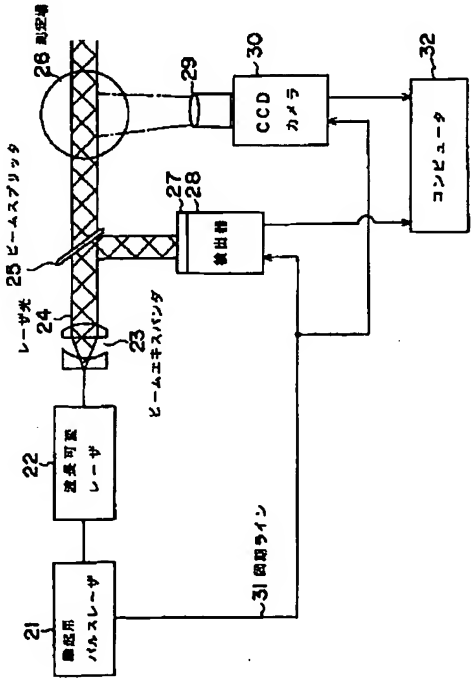
(54)【発明の名称】　レーザ光を用いた計測装置

(57)【要約】
【課題】ＬＩＦを用い測定場での被測定分子の濃度、温度を高精度計測する。
【解決手段】シート状のレーザ光24を出力して測定場26の被計測分子に照射するビームエキスパンダ23と、レーザ光24の照射により上記被測定分子が発する蛍光を入射して蛍光強度を測定するＣＣＤカメラ30と、上記ビームエキスパンダ23と上記測定場26の間に設け、レーザ光24の一部を分岐するビームスプリッタ25と、蛍光物質が塗布されたガラス板27に上記ビームスプリッタ25で分岐されたレーザ光24を入射し、該蛍光物質から発せられる蛍光強度を測定する検出器28と、この検出器28で得た蛍光強度により上記ＣＣＤカメラ30で得た測定場26での被測定分子が発する蛍光強度を正規化して出力するコンピュータ32とを備える。



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【特許請求の範囲】
【請求項１】　シート状のレーザ光を出力して測定場の被計測分子に照射するビームエキスパンダと、
レーザ光の照射により上記被測定分子が発する蛍光を入射して蛍光強度を測定する第１の計測手段と、
上記ビームエキスパンダと上記測定場の間に設け、レーザ光の一部を分岐するビームスプリッタと、
蛍光物質が塗布されたガラス板に上記ビームスプリッタで分岐されたレーザ光を入射し、該蛍光物質から発せられる蛍光強度を測定する第２の計測手段と、
この第２の計測手段で得た蛍光強度により上記第１の測定手段で得た測定場での被測定分子が発する蛍光強度を正規化する正規化手段とを具備したことを特徴とするレーザ光を用いた計測装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、レーザ誘起蛍光法を用いて２次元温度や濃度の計測等を行なうレーザ光を用いた計測装置に関する。
【０００２】
【従来の技術】レーザ誘起蛍光法（以下「ＬＩＦ」と略称する）は、被測定分子が有している吸収線と同一の周波数を持つレーザ光で測定場を照射し、濃度、温度計測に必要な信号光を得る手法である。
【０００３】従来のＬＩＦを用いた２次元濃度計測装置の概略構成を図２に示す。同図で励起用パルスレーザ１は色素レーザなどの波長可変レーザ２を発振させて、被測定分子の電子エネルギ差に対応した波長のレーザ光を出射させる。このレーザ光は、ビームエキスパンダ３にてシート状にされた後、測定場８に入射される。
【０００４】この測定場８に照射されたレーザ光７により励起された被測定分子から生じた蛍光は、レンズ４で集光されてＣＣＤカメラ５で撮像、計測される。このとき、励起用パルスレーザ１からＣＣＤカメラ５へレーザの発振と撮像の同期をとるための同期ライン６が配設される。
【０００５】上記被測定分子の濃度と測定場８での蛍光強度は比例するため、被測定分子の濃度は蛍光強度により決定されるが、同時に該蛍光強度はレーザ光７の強度にも比例するため、レーザ光７が照射されている計測領域におけるレーザ光強度分布の補正を行なう必要が生じる。
【０００６】そして、従来よりレーザ光７の強度分布を測定する方法としては、空気からのレーリ散乱光（レーザ光と同波長の分子散乱光）を利用する方法や、あるいは図３に示すようにビームエキスパンダ３の後段にレーザ光７の一部を分岐するビームスプリッタ１１を設けて、このビームスプリッタ１１で分岐したレーザ光７をフィルタ１２により撮影のための都合のよい輝度に減衰させた後にＣＣＤカメラ１３で撮像してその輝度から強

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度を検知する方法等があった。
【０００７】
【発明が解決しようとする課題】しかしながら、レーザ光強度の測定を行なうに際して、上記測定場からのレーリ散乱光を利用する方法では、測定場に空気などのバッファガスを導入する必要があり、被測定分子を導入しながらレーザ光強度分布を求めることができなかった。
【０００８】また、上記図３で示したビームスプリッタ１１によりレーザ光７を分岐し、分岐されたレーザ光を直接ＣＣＤカメラ１３で計測する方法では、ＣＣＤカメラ１３の計測部で干渉などの問題を生じ、誤差が発生しやすいという傾向があった。
【０００９】本発明は上記のような実情に鑑みてなされたもので、その目的とするところは、被測定分子を導入しながらレーザ光の強度分布を高い精度で測定することにより、結果として測定場での被測定分子の濃度、温度を高い精度で計測することが可能なレーザ光を用いた計測装置を提供することにある。
【００１０】
【課題を解決するための手段】すなわち本発明は、シート状のレーザ光を出力して測定場の被計測分子に照射するビームエキスパンダと、レーザ光の照射により上記被測定分子が発する蛍光を入射して蛍光強度を測定する第１の計測手段と、上記ビームエキスパンダと上記測定場の間に設け、レーザ光の一部を分岐するビームスプリッタと、蛍光物質が塗布されたガラス板に上記ビームスプリッタで分岐されたレーザ光を入射し、該蛍光物質から発せられる蛍光強度を測定する第２の計測手段と、この第２の計測手段で得た蛍光強度により上記第１の測定手段で得た測定場での被測定分子が発する蛍光強度を正規化する正規化手段とを備えたものである。
【００１１】このような構成とすることにより、上記正規化手段でレーザ光強度分布の補正を行なって被測定分子の蛍光強度を求めることができるため、被測定分子の濃度や温度などをきわめて高い精度で計測することができる。
【００１２】
【発明の実施の形態】以下、本発明の実施の一形態に係るレーザ光を用いた計測装置について図面を参照して説明する。図１はその概略構成を例示するもので、励起用パルスレーザ２１が色素レーザなどの波長可変レーザ２２を発振させ、被測定分子の電子エネルギ差に対応した波長のレーザ光を出射させる。
【００１３】この波長可変レーザ２２から出射されたレーザ光２４は、ビームエキスパンダ２３にてシート状にされた後、ビームスプリッタ２５にてその一部が予め設定された一定の割合で分岐され、残ったレーザ光がそのまま測定場２６へ、分岐されたレーザ光が蛍光物質を塗布したガラス板２７へそれぞれ入射される。
【００１４】このガラス板２７は、例えばＣＣＤライン

センサでなる検出器２８に対して取付けられたものであり、検出器２８はガラス板２７に塗布された蛍光物質から発生する蛍光の強度を、レーザ光２４の強度分布を表わすものとして検出する。

【００１５】一方、上記測定場２６に照射されたレーザ光２４により励起された被測定分子から生じた蛍光は、レンズ２９で集光されてＣＣＤカメラ３０で撮像、計測される。

【００１６】しかるに、上記検出器２８及びＣＣＤカメラ３０に対して上記励起用パルスレーザ２１から同期ライン３１が配設され、この同期ライン３１を介してレーザの発振と検出、撮像の同期をとるための信号が送達される。

【００１７】そして、検出器２８で検出されたレーザ光２４の強度分布に応じた蛍光強度、及びＣＣＤカメラ３０で得られた測定場８での蛍光強度は共にコンピュータ３２に送られる。

【００１８】コンピュータ３２では、ＣＣＤカメラ３０で得た測定場２６での被測定分子が発する蛍光強度を検出器２８で得た蛍光強度を用いて正規化演算することでＣＣＤカメラ３０の出力に対する補正を実行し、その演算結果から測定場２６における被計測分子の濃度または温度を求めて表示出力する。

【００１９】上記のような構成にあって、励起用パルスレーザ２１が波長可変レーザ２２を励振してレーザ光を出射させる一方、同期ライン３１を介して検出器２８、及びＣＣＤカメラ３０に同期信号を送出し、ガラス板２７に塗布された蛍光物質から発生する蛍光の強度、及び上記測定場２６に照射されたレーザ光２４により励起された被測定分子から生じた蛍光の強度をそれぞれ検出させ、コンピュータ３２へ送出させる。

【００２０】コンピュータ３２は、検出器２８で得た蛍光強度を除数としてＣＣＤカメラ３０で得た測定場２６での被測定分子が発する蛍光強度を除算する正規化演算を実行し、その商を測定場２６における被計測分子の濃度または温度として表示出力する。

【００２１】この場合、ガラス板２７に塗布された蛍光物質から発生する蛍光の強度を除数としたのは、該蛍光強度がレーザ光２４の強度分布に比例しているからであり、このような除数を用いて測定場２６での被測定分子が発する蛍光強度に対する除算を行なうことで、レーザ光２４の強度分布に基づいた正規化を施した、きわめて高い精度で測定場２６での被測定分子の濃度あるいは温度を計測することができるようになるものである。

【００２２】

【発明の効果】以上に述べた如く本発明によれば、被測定分子を導入しながらレーザ光の強度分布を高い精度で測定することにより、結果として測定場での被測定分子の濃度、温度を高い精度で計測することが可能なレーザ光を用いた計測装置を提供することができる。

【図面の簡単な説明】

【図１】本発明の実施の一形態に係る計測装置の概略構成を例示する図。

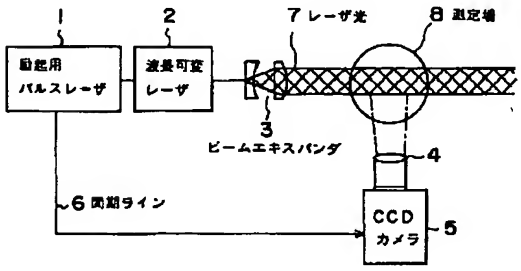
【図２】一般的なレーザ誘起蛍光法を用いた２次元濃度計測装置の概略構成を示す図。

【図３】図２に組合わせてレーザ光の強度分布を測定する構成を示した図。

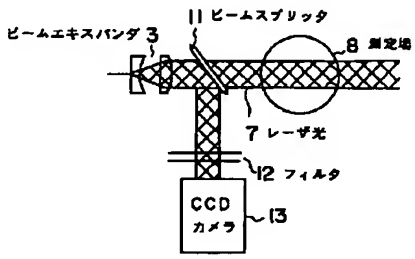
【符号の説明】

２１…励起用パルスレーザ
２２…波長可変レーザ
２３…ビームエキスパンダ
２４…レーザ光
２５…ビームスプリッタ
２６…測定場
２７…ガラス板
２８…検出器
２９…レンズ
３０…ＣＣＤカメラ
３１…同期ライン
３２…コンピュータ

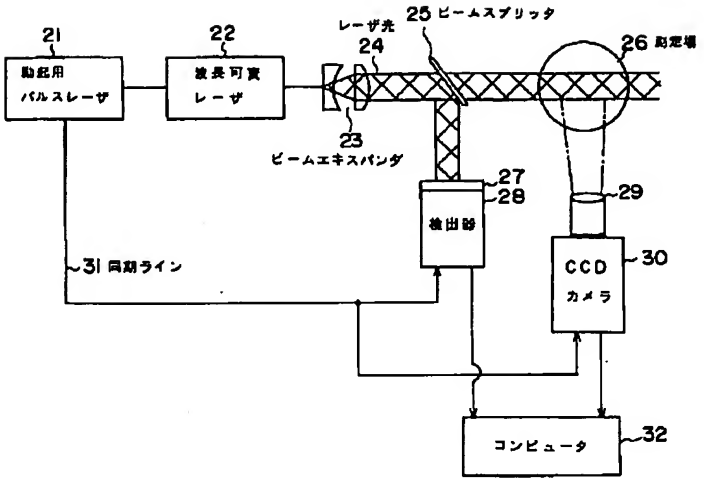
【図２】



【図３】



【図1】


21
励起用
パルスレーザ
22
波長可変
レーザ
レーザ光
24
25 ビームスプリッタ
26 測定場
23
ビームエキスパンダ
27
28
検出器
29
CCD
カメラ
30
31 同期ライン
コンピュータ
32

* NOTICES *

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2.**** shows the word which can not be translated.
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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing which illustrates the outline configuration of the metering device concerning one gestalt of operation of this invention.
[Drawing 2] Drawing showing the outline configuration of the two-dimensional concentration metering device using general laser induced fluorescence.
[Drawing 3] Drawing having shown the configuration which combines with drawing 2 and measures the intensity distribution of a laser beam.
[Description of Notations]
21 -- Pulse laser for excitation
22 -- Tunable laser
23 -- Beam expander
24 -- Laser beam
25 -- Beam splitter
26 -- Measuring space
27 -- Glass plate
28 -- Detector
29 -- Lens
30 -- CCD camera
31 -- Synchronous Rhine
32 -- Computer

[Translation done.]

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-210909

(43)Date of publication of application : 15.08.1997

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G01J 5/58
G01K 11/12

(21)Application number : 08-019925

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(71)Applicant : MITSUBISHI HEAVY IND LTD

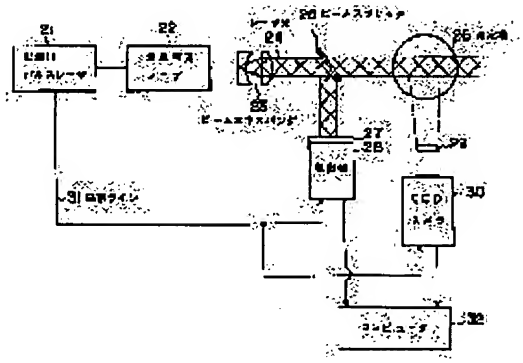
(72)Inventor : DEGUCHI YOSHIHIRO

(54) MEASURING DEVICE USING LASER BEAM

(57)Abstract:

PROBLEM TO BE SOLVED: To enhance the measuring accuracy of the concentration and temp. of molecules to be measured by determining the fluorescent intensity emitted from the molecules using a CCD camera, and subjecting the obtained intensity to a normalizing calculation process using a fluorescent intensity given by a sensor.

SOLUTION: A pulse laser for energization 21 energizes a variable wavelength laser 22 to emit a laser beam 24, and a synch. signal is fed to a sensor 28 and a CCD camera 30 through a synch. line 31, and the intensity of the fluorescent beam emitted by a fluorescent substance applied to a glass plate 27 and the intensity of fluorescent beam emitted by molecules to be measured which are energized with the laser beam 24 cast onto the measuring field 26 are sensed and fed to a computer 32. The computer 32 performs a normalizing calculation process such that the fluorescent intensity of the molecules in the field 26 given from the camera 30 is divided by the fluorescent intensity given from the sensor 28, and the obtained quotient is displayed and emitted as the concentration or temp. of the molecules in the field 26.



LEGAL STATUS

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converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the metering device using the laser beam which performs measurement of two-dimensional temperature or concentration etc. using laser induced fluorescence.
[0002]
[Description of the Prior Art] Laser induced fluorescence (it is called "LIF" for short below) is the technique of irradiating measuring space by the laser beam with the same frequency as the absorption line which the measured molecule has, and obtaining a signal light required for concentration and thermometry.
[0003] The outline configuration of the two-dimensional concentration metering device using the conventional LIF is shown in drawing 2 . The pulse laser 1 for excitation oscillates the tunable laser 2, such as dye laser, and carries out outgoing radiation of the laser beam of the wavelength corresponding to the electronic energy difference of a measured molecule in this drawing. After this laser beam is made into the shape of a sheet by the beam expander 3, incidence of it is carried out to the measuring space 8.
[0004] It is condensed with a lens 4, and the fluorescence produced from the measured molecule excited by the laser beam 7 irradiated by this measuring space 8 is picturized and measured with CCD camera 5. At this time, synchronous Rhine 6 for taking the oscillation of laser and the synchronization of an image pick-up from the pulse laser 1 for excitation to CCD camera 5 is arranged.
[0005] Since the concentration of the above-mentioned measured molecule is proportional to the fluorescence intensity in the measuring space 8, the concentration of a measured molecule is determined by fluorescence intensity, but since this fluorescence intensity is proportional also to the reinforcement of a laser beam 7 at coincidence, it will be necessary to amend the laser beam intensity distribution in the measurement field to which the laser beam 7 is irradiated.
[0006] and as an approach of measuring the intensity distribution of a laser beam 7 conventionally The approach of using the Rayleigh-scattering light (a laser beam and molecule scattered light of this wavelength) from air, Or as shown in drawing 3 , the beam splitter 11 which branches in a part of laser beam 7 is formed in the latter part of the beam expander 3. After making brightness with the sufficient convenience for photography decrease the laser beam 7 which branched by this beam splitter 11 with a filter 12, the approach of picturizing with CCD camera 13 and detecting reinforcement from that brightness etc. was.
[0007]
[Problem(s) to be Solved by the Invention] However, it faced measuring laser beam reinforcement, and by the approach of using the Rayleigh-scattering light from the above-mentioned measuring space, buffer gases, such as air, needed to be introduced into measuring space, and laser beam intensity distribution were not able to be searched for, introducing a measured molecule.
[0008] Moreover, by the approach of branching a laser beam 7 by the beam splitter 11 shown by above-mentioned drawing 3 , and measuring the branched laser beam with direct CCD camera 13, problems, such as interference, were produced in the measurement section of CCD camera 13, and there was an inclination to be easy to generate an error.
[0009] This invention was made in view of the above actual condition, and the place made into the purpose is by measuring the intensity distribution of a laser beam in a high precision to offer the metering device using the laser beam which can measure the concentration of the measured molecule in measuring space, and temperature in a high precision as a result, introducing a measured molecule.
[0010]
[Means for Solving the Problem] Namely, the beam expander which this invention outputs a sheet-like laser beam and

irradiates the measured molecule of measuring space, The 1st measurement means which carries out incidence of the fluorescence which the above-mentioned measured molecule emits by the exposure of a laser beam, and measures fluorescence intensity, The beam splitter which prepares between the above-mentioned beam expander and the above-mentioned measuring space, and branches in a part of laser beam, The 2nd measurement means which measures the fluorescence intensity which carries out incidence of the laser beam which branched by the above-mentioned beam splitter to the glass plate with which the fluorescent material was applied, and is emitted from this fluorescent material, It has a normalization means to normalize the fluorescence intensity which the measured molecule in the measuring space obtained with the measurement means of the above 1st by the fluorescence intensity obtained with this 2nd measurement means emits.

[0011] Since the above-mentioned normalization means can amend laser beam intensity distribution and it can ask for the fluorescence intensity of a measured molecule by considering as such a configuration, concentration, temperature, etc. of a measured molecule are measurable in a very high precision.

[0012]

[Embodiment of the Invention] Hereafter, the metering device using the laser beam concerning one gestalt of operation of this invention is explained with reference to a drawing. The outline configuration is illustrated, the pulse laser 21 for excitation oscillates the tunable laser 22, such as dye laser, and drawing 1 carries out outgoing radiation of the laser beam of the wavelength corresponding to the electronic energy difference of a measured molecule.

[0013] The laser beam 24 by which outgoing radiation was carried out from this tunable laser 22 branches at a fixed rate that that part was beforehand set up by the beam splitter 25 after being made the shape of a sheet by the beam expander 23, and incidence of the laser beam which remained is carried out to the glass plate 27 with which the branched laser beam applied the fluorescent material to the measuring space 26 as it was, respectively.

[0014] This glass plate 27 is attached to the detector 28 which becomes with a CCD line sensor, and a detector 28 detects the reinforcement of the fluorescence generated from the fluorescent material applied to the glass plate 27 as a thing showing the intensity distribution of a laser beam 24.

[0015] It is condensed with a lens 29, and the fluorescence produced from the measured molecule excited on the other hand by the laser beam 24 irradiated by the above-mentioned measuring space 26 is picturized and measured with CCD camera 30.

[0016] However, synchronous Rhine 31 is arranged from the above-mentioned pulse laser 21 for excitation to the above-mentioned detector 28 and CCD camera 30, and the signal for taking the oscillation of laser, and detection and the synchronization of an image pick-up through this synchronous Rhine 31 is sent.

[0017] And both the fluorescence intensity according to the intensity distribution of the laser beam 24 detected with the detector 28 and the fluorescence intensity in the measuring space 8 obtained with CCD camera 30 are sent to a computer 32.

[0018] By computer 32, by carrying out the normalized arithmetic of the fluorescence intensity which the measured molecule in the measuring space 26 obtained with CCD camera 30 emits using the fluorescence intensity obtained with the detector 28, amendment to the output of CCD camera 30 is performed, and a display output is carried out in quest of the concentration or temperature of a measured molecule in the measuring space 26 from the result of an operation.

[0019] While it is in the above configurations, the pulse laser 21 for excitation excites tunable laser 22 and outgoing radiation of the laser beam is carried out A synchronizing signal is sent out to a detector 28 and CCD camera 30 through synchronous Rhine 31. The reinforcement of the fluorescence generated from the fluorescent material applied to the glass plate 27 and the reinforcement of the fluorescence produced from the measured molecule excited by the laser beam 24 irradiated by the above-mentioned measuring space 26 are made to detect, respectively, and it is made to send out to a computer 32.

[0020] A computer 32 performs the normalized arithmetic which does the division of the fluorescence intensity which the measured molecule in the measuring space 26 obtained with CCD camera 30 by making into a divisor fluorescence intensity obtained with the detector 28 emits, and carries out the display output of the quotient as the concentration or temperature of the measured molecule in the measuring space 26.

[0021] In this case, having made into the divisor reinforcement of the fluorescence generated from the fluorescent material applied to the glass plate 27 By doing the division to the fluorescence intensity which is because this fluorescence intensity is proportional to the intensity distribution of a laser beam 24, and the measured molecule in the measuring space 26 emits using such a divisor The concentration or temperature of a measured molecule in the measuring space 26 can be measured now in a very high precision which performed normalization based on the intensity distribution of a laser beam 24.

[0022]

[Effect of the Invention] As stated above, the metering device using the laser beam [according to this invention] which can measure the concentration of the measured molecule in measuring space and temperature in a high precision as a result by measuring the intensity distribution of a laser beam in a high precision, introducing a measured molecule can be offered.

[Translation done.]

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ABSTRACT:

PROBLEM TO BE SOLVED: To enhance the **measuring** accuracy of the concentration and **temp. of molecules to be measured** by determining the fluorescent intensity emitted from the molecules using a CCD camera, and subjecting the obtained intensity to a normalizing calculation process using a fluorescent intensity given by a sensor.

SOLUTION: A pulse **laser** for energization 21 energizes a variable wavelength **laser** 22 to emit a **laser** beam 24, and a synch. signal is fed to a sensor 28 and a CCD camera 30 through a synch. line 31, and the intensity of the

fluorescent beam emitted by a fluorescent substance applied to a glass plate 27 and the intensity of fluorescent beam emitted by molecules to be **measured** which are energized with the **laser** beam 24 cast onto the **measuring** field 26 are sensed and fed to a computer 32. The computer 32 performs a normalizing calculation process such that the fluorescent intensity of the molecules in the field 26 given from the camera 30 is divided by the fluorescent intensity given from the sensor 28, and the obtained quotient is displayed and emitted as the concentration or **temp. of the molecules** in the field 26.